

infallible, the writer still believes that there are not nearly enough x-ray examinations being made. When routine x-ray examinations are not made, it is surprising how many patients are diagnosed as tuberculous and even sent to a sanitarium without the disease.

Referring to Doctor Carter's question of whether or not tracheobronchial tuberculous lesions are of any great significance in a preventive program, the writer does not consider these lesions a major problem as tracheobronchial tuberculosis is not a contagious disease, and the patients who have it seldom die. What he does consider the all-important part is that more stress must be laid on the recognition of tuberculosis in the adult, for he is the one that infects the child. Theoretically speaking, if we were to isolate all adults who have tuberculosis, we would not have tuberculosis in children. Of course we must diagnose the disease early in children and adults in order to save their lives.

The author agrees with Doctor Bush that films should be used instead of screens, or fluoroscopic examinations. The high percentage of tuberculosis that we found might be explained by our careful mode of selecting cases for examination, and the fact that there is a high percentage of Mexicans in our population.

Concerning the use of the word "activity," Doctor Siefert has stressed what the author had in mind, that if we wait until clinical symptoms manifest themselves, the patient many times will be in a dangerous condition. While, with pathologic activity, the disease is usually localized or in its early stages.

THE THERAPEUTIC VALUE OF THE HYPEREXIA BATH

By ARTHUR N. DONALDSON, M. D.
Long Beach

DISCUSSION by Merrill W. Hollingsworth, M. D., Santa Ana; Henry Mehrtens, M. D., and P. S. Pouppirt, M. D., Stanford University Hospital, San Francisco.

EVERY important contribution to the literature on the physiology of fever for the past thirty years offers the conclusion that temperature elevation renders a distinct defensive service to the body. It is the physician's experience that usually the patient with the highest temperature is the sickest. Hewlett¹ tells us, however, that this is not an indication that the high temperature is itself an unfavorable form of reaction, but that the disturbing factor is the severity of the infection. In other words, the degeneration of internal organs in the course of febrile diseases is due to the infection and not to the high temperature.

COMMENTS ON THE LITERATURE

MacCallum² of Johns Hopkins may be quoted as follows: "The febrile process is a reaction beneficial to the organism and, doubtless, intimately associated with the development of protective substances." MacCallum's observation seems to be substantiated by the work of Rolly and Meltzer,³ who, led by their theory of the functional value of fever, found that the overheating of the body increased the formation of agglutinins, bacteriolysins, and antitoxins. In another very interesting piece of work conducted by these German investigators, they seem to have fully proved their claim that fever is a defensive function. Two groups of animals were selected and

to each was given daily, by subcutaneous route, from one-fourth to one-half of the fatal dose of either staphylococci, pneumococci, or *Bacillus coli communis*. One group was daily heated up to 104 degrees Fahrenheit and held at that temperature for a given period of time. Results: the unheated group all died. The heated group all lived longer than the control, and one-half of them survived.

Hewlett¹ reports an experiment that parallels that of Rolly and Meltzer in results. A hyperthermia was produced in animals through the use of the steam cabinet, or by puncture of the heat centers at the base of the brain, or by the injection of some aseptic pyrogenic material. It was determined that erysipelas and infections from staphylococci, pneumococci, and the diphtheria bacilli ran a shorter and a milder course.

Hewlett also reports that the body temperature of rabbits has been kept at 105.8 degrees Fahrenheit, and over, for weeks at a time without serious damage to the tissues. An interesting sidelight on this evidence of the harmlessness of hyperthermia is the observation by Ott⁴ and others that tissue protection in the presence of elevated temperature depends upon an abundant supply of non-nitrogenous energy-producing food. For every increase of one degree in the temperature of the body, heat production increases six per cent. This is supposed to be due to the specific dynamic action of amino-acids. Yet the actual protein destruction in the presence of hyperthermia alone is very small, provided, of course, that nutrition has been properly maintained.

Hewlett¹ quotes Winternitz to the effect that in a hot bath the absorption of oxygen and the excretion of carbon dioxide is far in excess of that observed in an infectious fever, and that the coefficient approached closely to that observed in strenuous muscular exercise. We are reminded by these facts that a fever should not be starved, and that hyperthermia, if used therapeutically, will prove less exhausting if sufficient energy food has been provided to prevent an attack on the body proteins.

CLINICAL OBSERVATIONS NOTED IN THE LITERATURE

One of the oldest of therapeutic procedures is the hot bath. We have recently learned, however, that if we make the bath hotter and keep the patient in longer, the bath will prove of far greater therapeutic value than our previous experience has indicated. Schamberg,⁵ Frazier,⁶ Hollingsworth,⁷ Brown,⁸ and Mehrtens⁹ have all contributed to the literature within the past four years and, with one exception, report results that are so convincing that we are compelled to recognize the hyperpyrexia bath as a measure of widening therapeutic value. The one exception is Hollingsworth of White Memorial Hospital, and his technique is so obviously at fault that his conclusions are worthless.

Schamberg⁵ and Frazier⁶ report favorably on the treatment of experimental syphilis in rabbits by the use of baths at 113 degrees Fahrenheit.

Brown,⁸ working with human subjects, reports rapid improvement of gout and fibrositis with baths 104 to 108 degrees Fahrenheit.

Mehrtens⁹ has evidently given this procedure the greatest amount of study, and his reports indicate an unbiased effort to obtain the facts. He states that pain from disturbances in muscles, nerves, and joints proved especially amenable to treatment. He has treated encephalitis and Parkinson's syndrome following encephalitis, as well as combined sclerosis, with cheering results. He reports improvement in paresis and tabes, with favorable serological findings following courses. The baths were especially effective in controlling lightning pains and gastric crises. Mehrtens required a body temperature of 104 to 107 degrees Fahrenheit. He maintains this hyperthermia for from forty-five to sixty minutes, and sometimes by wrapping the patient in blankets, is continued. The frequency of the bath depends altogether upon the vitality of the patient: some daily, others once a week. A series usually is constituted of fourteen baths.

He found that a patient would lose between three and five pounds with each bath, but that this would be gained back within twenty-four hours. The appetite was usually improved by the treatment. Both systolic and diastolic blood pressure showed a substantial drop. Hemoglobin and red cell count, when influenced at all, showed a uniform increase.

AUTHOR'S OBSERVATIONS

Our interest in this subject began about a year ago, when Mehrtens reported on the treatment of paralysis agitans by this method. We happened to have three cases under the usual unsatisfactory program at that time, and thought it would be worth while to grasp any possibility. Two were treated, one taking a course of twenty baths, and the other ten. Both were of the arteriosclerotic type, a type recognized as the most unresponsive, and both were very materially benefited. A period of six months has elapsed now, and one of these patients, a man in his seventies, has retained much of the benefits derived. We have lost track of the other man. The third, untreated, has made the usual progress, downward.

In the past six months we have used the hyperpyrexia bath in chronic Neisserian infections, prostatitis, arthritis, acute colds, nephritis, neurasthenia, and tabes. We have observed clinical improvement in all. Patients with chronic arthritis, whom we have treated for a year and a half by every other theory and system but to no avail, have responded to the hot bath. We are just now treating a chronic Neisserian infection that has resisted all stock efforts, and is now responding after four baths.

In order to learn something of the effect of the bath on the body chemistry, we checked the carbon dioxid combining power and the non-protein nitrogen of the blood, and the p_{H} of the urine, on four different patients before and after the bath. The figures are as given in Table 1.

TABLE 1.—Effect of Baths on Body Chemistry

Patient		N. P. N.	Vol. per cent CO ₂	p _H of Urine
No. 1	Before bath	29.1	51.9	5.6
	After bath	30.6	53.9	6.
No. 2	Before bath	31.6	51.1	6.
	After bath	36.15	48.23	6.
No. 3	Before bath	23.7	50.63	6.2
	After bath	29.7	46.33	6.
No. 4	Before bath	27.4	51.43	5.2
	After bath	28.6	50.41	6.

The above is a small group, too small to offer as material for conclusive evidence, but it is at least suggestive that the alkaline tide is not seriously affected. It is interesting to note that in patient No. 1 the carbon dioxid combining power was actually increased. The p_{H} of the urine was markedly changed for the better in patients Nos. 1 and 4, the other two remaining stationary. Inasmuch as the protective response of the blood is influenced by the reaction of tissue fluids, these findings are interesting, for they indicate a favorable medium for the building up of a defense. The nonprotein nitrogen was raised in each instance, but not sufficiently to indicate any major tissue disintegration. No. 1 had the bath within an hour after a good meal. There was very little increase, indicating a protein saving by reason of available energy food. The other two had baths four to six hours after eating.

The blood count was checked in each case, and the findings in hemoglobin and red cell count paralleled Mehrtens', *i. e.*, if influenced at all, it showed an increase. We have found no record of the leukocyte and polynuclear count in the literature and so present it.

This certainly indicates a favorable reaction and substantiates the claim of Rolly and Meltzer,³ that the defensive elements of the blood are mobilized.

Our technique calls for the gradual rise of body temperature (recorded by mouth) to 104 or 105 degrees Fahrenheit, according to the response of the patient, and the maintenance of this point for forty-five to sixty minutes. The temperature of the bath is then gradually reduced to the recovery of normal. The patient is then put on a cot, comfortably covered, and allowed to rest for an hour. We repeat the bath from one to three times a week, according to the patient's vitality and response.

TABLE 2.—Effect of Baths on Leukocytes and Polynuclears

Patient		Total Whites	Per cent Polynuclears
No. 1	Before bath	6,000	67
	After bath	7,400	77
No. 2	Before bath	8,000	52
	After bath	8,400	70
No. 3	Before bath	7,000	61
	After bath	9,600	78
No. 4	Before bath	4,000	50
	After bath	5,000	60

COMMENT

We have long used foreign proteins for the anaphylactic reaction obtained. When injected they would cause a disintegration of other proteins in the body, and certain products of this change would act directly upon the heat centers. The beneficial effects, if any, are due to the fever resulting from an unbalancing of the heat regulating mechanism.

Nonspecific vaccines, and inoculation of luetics with malaria and other fever-producing organisms, draws value from the same fact—temperature elevation. In our opinion these are poor substitutes for the hyperpyrexia bath. The bath means more work for the physician and his nurses, but it means less discomfort and suffering to the patient, and the results are eminently more satisfactory to everybody concerned.

The bath is well tolerated by the aged, arteriosclerotic, the frail anemic. The greatest difficulty is with a nervous woman, who would probably be a whirlwind of despair anywhere or any time. We had a prizefighter who would become a bit groggy as the temperature elevated, and his pet diversion was to attempt an uppercut on the technician. We have been compelled to shorten the time occasionally for the first time because of the temperament and fear, but, in the main, the difficulties in handling the patient's idiosyncrasies are negligible.

The bath seems to act as a general rejuvenating agent. After the immediate period of exhaustion, a quick recovery is the rule; the appetite is stimulated and a subjective sense of improvement experienced. Sajous¹⁰ claims that heat is a general endocrine stimulant, and that the 'hyperthermia causes the hormones to stir up the defensive mechanism against toxemia and infection. Sajous' is an interesting theory, and some day we may have the evidence whether or no the endocrines offer the *modus operandi* for the results we behold.

CONCLUSIONS

1. The hyperpyrexia bath is a therapeutic procedure of distinct importance in the treatment of a wide range of acute and chronic diseases.

2. To be effective the mouth temperature of the patient while in the bath should range between 104 to 105 degrees Fahrenheit, and should be maintained for from forty-five to sixty minutes.

3. A course consists of ten to twenty baths, given three times a week, or less frequently, according to the condition of the patient and his reaction to the treatment.

4. The bath should displace foreign protein and nonspecific vaccine therapy for the reason that it is more rational and far more certain of producing the physiological response sought for by treatment.

211 Cherry Avenue.

REFERENCES

1. Hewlett, Albion W.: *Pathological Physiology of Internal Diseases*. 1928.
2. MacCallum: *Harvey Lect.* 1908-9.

3. Rolly and Meltzer: *Deutsches Arch. f. Klin. Med.* 1908.

4. Ott, Isaac: *Fever—Its Thermolaxis and Metabolism*. 1915.

5. Schamberg: *Studies of the Therapeutic Effect of Fever in Experimental Lues*, *Arch. Dermat. and Syph.*, 14:243.

6. Frazier, C. N.: *Effect of Elevation of Body Temperature on Course of Experimental Syphilis in the Rabbit*, *Arch. Dermat. and Syph.*, 16:443.

7. Hollingsworth, M. W.: *Hot Baths in the Treatment of Late Syphilis*, *Arch. Dermat. and Syph.*, 18:736.

8. Brown: *Treatment by Hyperpyrexia Baths*, *Proc. Roy. Soc. Med.*, 104:108, 1929.

9. Mehrtens, H. G., and Pouppirt, P. S.: *Hyperpyrexia Produced by Baths*, *Arch. Neurol. and Psychiat.*, 22:700. Pouppirt, P. S.: *Treatment of Parkinson's Syndrome with Fever Produced by Baths*, *California and West. Med.*, 31:3 (Sept.), 1929.

10. Sajous, C. E.: *Sajous' Analytic Cyclopedic of Practical Medicine*.

DISCUSSION

MERRILL W. HOLLINGSWORTH, M. D. (613 First National Bank Building, Santa Ana).—This fascinating idea of killing every spirochaete *in situ* in the body at one blow by some sort of heat has led to an enormous amount of literature. A recent number of the *Urological and Cutaneous Review* shows a bibliography of eighty-one different citations on heat therapy in syphilis alone.

Hewlett's observation on keeping rabbits at 105.8 degrees Fahrenheit without tissue damage loses significance when one remembers the normal temperature of the rabbit ranges from 103.2 to 104.4 and that 105.8 degrees Fahrenheit in the rabbit compares to 100 degrees Fahrenheit in man. Schamberg's first report did look somewhat favorable; a subsequent report on application of the hot bath to human syphilis was not enthusiastic; a personal letter to me stated he was withholding judgment entirely, and he later gave up this line of investigation altogether. Frazier admittedly used a very small series of animals, only six; and his own words are, "These results are not in complete accord with those of Schamberg and Rule." "Body temperatures varying from 106.2 to 110.6 F. (rectal) . . . resulted in definite inhibition of the clinical progress of the disease in three animals . . . and in complete suppression . . . in one animal." But . . . "elevations of body temperature within the range of those obtainable with safety in man, . . . 103.5 to 106.7 F., . . . were without significant influence on the clinical course of a syphilitic infection . . . in six animals . . . there was no demonstrable difference between the clinical course of the disease as observed in the test animals and that in the untreated animals." Brown's work was apparently on conditions other than syphilis, and Mehrtens reported beneficial results on such things as body aches and pains—the family hot-water bottle is still in use—but not much, if any, curative action on syphilis itself.

I was interested in investigating the effect of the hot bath on syphilis in man. As I am not a physical therapist, I consulted with members of the physical therapy department of the White Memorial Hospital about carrying out such an investigation. This institution has a personnel trained for years in physical therapy, and apparently has unlimited equipment for this work. I selected forty-two patients from those coming to the syphilis clinic to turn over to the physical therapy department. The personnel of the department was enthusiastic, as they had always "believed physical therapy would some day play a large rôle in the treatment or cure of syphilis." We had no precedent to start with, no rules to follow but the dictates of our own judgment, regarding the safe limit in either heat or duration of the bath. It was difficult to get a reliable sublingual temperature because the pa-

tients would have the greatest difficulty in keeping the mouth closed during the bath. The highest sublingual temperature actually recorded was only 105.4 degrees Fahrenheit; but the highest water temperature was 113 degrees Fahrenheit. The patients were given all we felt they could tolerate. All the work was supervised and carried out by experienced physical therapists. As noted in my report, the effect on the first group of five patients was apparently so deleterious I hesitated to extend the investigation until these patients could be observed more fully. My report was not written up until a year later, at which time four still had four plus blood Wassermann reactions and one, two plus. All of the patients lost weight and were, as a group, weaker and in poorer health after the treatment than before. There was no evidence leading me to believe the spirochetes had been killed *in situ* in any of the patients or that their condition as syphilitic patients had been in any way improved by the heat.

Bessemans investigated thoroughly the effect of local and general heat as produced by playing streams of hot water on the part, complete immersion, hot-air incubators, hot-air convection with a blower and heat from actinic apparatus, using a thermoelectric needle to ascertain temperature and using rabbits and human subjects. Water in the immersion baths on humans reached 113 degrees Fahrenheit. Eighty-two chancre patients and several secondary cases were treated. He says of the immersion baths, "No action appeared on the miliary syphilids of the intact epithelium. The appearance of new syphilids was not prevented. The Wassermann pursued its normal evolution. This treatment does not favor clinical cure." Carpenter investigated the effect of heat produced by short radio waves (a very ideal method of producing heat in the animal body) on twenty-five syphilitic rabbits. One died from the heat; there was a suppression of clinical manifestations in the majority, but a cure is not claimed in a single instance.

Taking into consideration the rabbit's vastly greater resistance to infection with human syphilis and its much higher normal temperature, the experiments reported would not lead one to believe that heat within the range tolerated by man would have much influence on human syphilis. Hot baths were tried repeatedly when the disease was first recognized.

I have the complete works of eleven syphilographers, writing before 1565 A. D., mentioning the hot bath, the earliest being 1499 A. D. One cannot help but admire the intelligence and keen observation of one author, who, writing in 1563, says, "In the meantime the warm Bath, whether natural or artificial, weakens the Patient to no Purpose. For there are few or none that have been cured either by the external or internal Use of the hot mineral Waters. Or, if some have found themselves relieved by the hot Bath, they have soon relapsed, and sometimes into a worse than their former State."

The very dogmatic statement, "Nonspecific vaccines, and inoculation of luetics with malaria and other fever-producing organisms, draws value from the same fact—temperature elevation," is open to argument as well as the last conclusion, "the bath should displace foreign protein and nonspecific vaccine therapy for the reason that it is more rational and far more certain of producing the physiological response sought for by treatment." Joseph E. Moore, *Journal of the American Medical Association*, November 28, 1931, page 1586, says that fever is not the only factor in malaria therapy.

Wagner-Jauregg's assistant, Gerstmann, told me personally he believed their results at Vienna with malaria therapy were superior to those reported elsewhere because they have an almost afebrile strain of malaria which they have kept so by using only man-to-man transmission.

Bessemans says, "It is not unknown to us that some authors (Gerstmann, Weygandt, Muhlen, Kirschbaum, and others) report lasting remission in general

paralysis, where the malarial treatment has produced no lasting elevations of temperature; that even certain rare cases have been reported (Hermann, Brutsch) where the impaludation pursued an almost afebrile course, and where, nevertheless, favorable results occurred."

Joseph Schumacher has carried out exhaustive experiments to try to determine what the curative factor in so-called fever therapy is. His conclusions are that the fever has nothing whatever to do with the curative influence. Permit me to quote this author who used numerous antigens, yeast, sterile milk, lipoids, etc.: "The mode of action of malaria therapy, according to our present investigation, is based upon the extensive destruction of red blood corpuscles and other tissue cells (spleen, etc.) through the infection, with the resultant development of autogenous lipid-albumin compounds, which occur in a similar way, following the syphilitic infection of a tissue. These lipid-albumins also act as an antigen in this case, the symptoms of the defensive activity of the system being expressed by an increased production of lipoproteolytic ferments. It is to the action of these ferments that those spirochetes succumb which are located in the brain and cord, and which are otherwise out of our reach.

"It is also probable that after the cure of the malarial infection with quinin, and the subsequent flooding of the system with innumerable dead plasmodia, foreign lipid-albumin compounds (from the plasmodia) also cause the production of ferments."

This brings into question the interpretation of fever as being the beneficial factor in all cases where some form of parenteral antigen has been used, such as that reported by Rolly and Meltzer. After all, fever may be a post hoc propter hoc observation.

Hardesty of the University of Kansas applied Schumacher's conclusions in giving 467 injections of lipid-protein to seventy-five syphilis patients in all stages. Chills and fever occurred in only three patients, on the day following the first or second injection. The maximum febrile elevation was only 0.87 degrees centigrade. Five advanced cases of paresis showed one remission, two improved, and two unimproved; one paretic not advanced had a remission; results surely comparable to malaria therapy. Hardesty's conclusions are: "(2) The method is convenient, safe, and practically free from unpleasant after-effects. (3) Increase in appetite and weight, with disappearance of subjective symptoms, is early and striking. . . (6) Improvement is apparently not due to the fever, as the rise in temperature is slight and frequently absent."

It is my opinion that the hot bath has no place whatever in the serious treatment of human syphilis, nor can it in any way be substituted for nonspecific protein or lipoprotein therapy on account of the absence of the essential antigenic factor. I believe that heat *per se* or heat produced by physical means, in treating human syphilis, is not only valueless but actually harmful.

✱

HENRY MEHRTENS, M. D., AND P. S. POUPPIRT, M. D. (Stanford University Hospital, San Francisco).—The clinical improvement observed in patients after hyperpyrexia produced by baths cannot be adequately explained until a great deal more is understood about its results on blood chemistry. Doctor Donaldson's paper is an effort along the right lines, as only by such an understanding can we get from this method of therapy its full usefulness. We shall be interested in following Doctor Donaldson's work along these lines, particularly when his series has proportions large enough to permit statistical handling.

After our experience with a series of more than fourteen thousand hyperpyrexial baths we are convinced of the therapeutic usefulness of the method in careful hands, but we are still intrigued by the question of just why the improvement occurs.